NIST HANDBOOK 150-1
2007 Edition (DRAFT)

National Voluntary Laboratory Accreditation Program

ENERGY EFFICIENT LIGHTING PRODUCTS

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Foreword

The NIST Handbook 150 publication series sets forth the procedures, requirements, and guidance for the accreditation of testing and calibration laboratories by the National Voluntary Laboratory Accreditation Program (NVLAP). The series is comprised of the following publications:

- NIST Handbook 150, *NVLAP Procedures and General Requirements*, which contains the general procedures and requirements under which NVLAP operates as an unbiased third-party accreditation body;

- NIST Handbook 150-xx program-specific handbooks, which supplement NIST Handbook 150 by providing additional requirements, guidance, and interpretive information applicable to specific NVLAP laboratory accreditation programs (LAPs).

The program-specific handbooks are not stand-alone documents, but rather are companion documents to NIST Handbook 150. They tailor the general criteria found in NIST Handbook 150 to the specific tests, calibrations, or types of tests or calibrations covered by a LAP.

NIST Handbook 150-1, *NVLAP Energy Efficient Lighting Products*, presents the technical requirements and guidance for the accreditation of laboratories under the NVLAP Energy Efficient Lighting Products LAP. The 2007 edition incorporates changes resulting from the release of the newest editions of ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*, and NIST Handbook 150, as well as editorial improvements. The 2007 edition of NIST Handbook 150-1 supersedes and replaces the 1994 edition.

The handbook was revised with the participation of technical experts in the field of energy efficient lighting products testing and was approved by NVLAP. The following main changes have been made to this handbook with respect to the previous edition:

- all references to applicable international guides and standards have been updated;

- on-site assessment checklists and the test method selection list are no longer included in order that they may be provided as separate documents, which may be updated at different intervals than the handbook;

- the body of the handbook has been restructured to conform with internationally accepted rules for the structure and drafting of standards, where appropriate, to promote ease of use and understanding.

This handbook is also available on the NVLAP web site (http://www.nist.gov/nvlap).

Questions or comments concerning this handbook should be submitted to NVLAP, National Institute of Standards and Technology, 100 Bureau Drive, Stop 2140, Gaithersburg, MD, 20899-2140; phone: 301-975-4016; fax: 301-926-2884; e-mail: nvlap@nist.gov.

Introduction

{UNDER REVIEW}

1 General information

1.1 Scope

1.1.1 NIST Handbook 150-1 specifies the technical requirements and provides guidance for the accreditation of laboratories under the NVLAP Energy Efficient Lighting Products Laboratory Accreditation Program (EEL Program). It supplements the NVLAP procedures and general requirements found in NIST Handbook 150, *NVLAP Procedures and General Requirements*, by tailoring the general criteria found in NIST Handbook 150 to the specific tests and types of tests covered by the EEL Program.

1.1.2 NIST Handbook 150, NIST Handbook 150-1, and their respective checklists (see 1.6) constitute the collective body of requirements that must be met by a laboratory seeking NVLAP accreditation for the EEL Program.

1.1.3 This handbook is intended for information and use by accredited EEL laboratories, assessors conducting on-site assessments, laboratories seeking accreditation, other laboratory accreditation systems, users of laboratory services, and others needing information on the requirements for accreditation under the EEL Program.

1.2 Organization of handbook

The numbering and titles of the first five clauses of this handbook match those of NIST Handbook 150. The primary subclauses in clauses 4 and 5 (e.g., 4.1, 4.2, etc.) are also numbered and titled to correspond with the subclauses in NIST Handbook 150, even when there are no requirements additional to those in NIST Handbook 150.

1.3 Program description

1.3.1 The NVLAP EEL Program provides for laboratory accreditation to ensure that standard test procedures are followed to measure electrical, photometric, colorimetric, and life-performance characteristics of incandescent, fluorescent and high intensity discharge lamps, and to measure the photometric characteristics of luminaries (lighting fixtures). The EEL Program accredits laboratories that use test methods from the Illuminating Engineering Society (IES) and the American National Standards Institute (ANSI).

1.3.2 A listing of the test methods included in the NVLAP program is given in the EEL Test Method Selection List, which is part of the EEL application package and available from NVLAP upon request. The Test Method Selection List is grouped into tests for lamps and luminaires (lighting fixtures). A laboratory may seek accreditation to all of the selected methods offered in the EEL Program or a subset of its choice. A laboratory may request test methods to be added to the program. Test method additions will be handled in accordance with NVLAP procedures in NIST Handbook 150 for adding to or modifying an established LAP (see NIST Handbook 150, clause 2).

1.4 References

The following documents are referenced in this handbook. For dated references, only the edition cited applies. If no date is given in the reference, then the latest edition (including any amendments) shall apply within one year of publication or within another time limit specified by regulations or other requirement documents.

— ANSI/IESNA RP-16-05, *Nomenclature and Definitions for Illuminating Engineering*, Illuminating Engineering Society of North America

— ASTM E178, *Standard Practice for Dealing with Outlying Observations*

— CIE Publication No. 13.2, *Method of Measuring and Specifying Color Rendering of Light Sources*, Commission Internationale de l'Eclairage

— ENERGY STAR *Program Requirements for CFLs: ENERGY STAR Eligibility Criteria, Energy-Efficiency Criteria - Version 3.0*

— ENERGY STAR *Program Requirements for CFLs: ENERGY STAR Eligibility Criteria, Energy-Efficiency Criteria - Version 4.0 - Draft*

— ENERGY STAR *Program Requirements for Residential Light Fixtures: Eligibility Criteria – Version 4.0*

— ENERGY STAR *Program Requirements for Residential Ceiling Fans: Eligibility Criteria – Version 2.1*

— IES LM-16, *Practical Guide to Colorimetry of Light Sources*, Illuminating Engineering Society of North America

— *IESNA Lighting Handbook*, Illuminating Engineering Society of North America, 2000

— NIST Handbook 150, *NVLAP Procedures and General Requirements*

1.5 Terms and definitions

For the purposes of this handbook, the terms and definitions given in NIST Handbook 150 and ANSI/IESNA RP-16-05 apply. In particular, the following are provided from ANSI/IESNA RP-16-05.

1.5.1
color rendering index (CRI) (of a light source)
Measure of the degree of color shift objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference source of comparable color temperature.

1.5.2
lamp
A generic term for a man-made source created to produce optical radiation. By extension, the term is also used to denote sources that radiate in regions of the spectrum adjacent to the visible.

1.5.3
luminaire (light fixture)
A complete lighting unit consisting of a lamp(s) and ballast(s) (when applicable) together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply.

1.6 Program documentation

1.6.1 General

Assessors use NVLAP checklists to ensure that each laboratory receives an assessment comparable to that received by others and to assure completeness, uniformity, and objectivity. Checklists assist assessors in documenting the assessment to the NVLAP requirements found in NIST Handbook 150, this handbook, and the checklists themselves. Checklists contain definitive statements or questions about all aspects of the NVLAP requirements for accreditation and form part of the On-Site Assessment Report (see NIST Handbook 150). The current version of each checklist is available from the NVLAP web site at <http://www.nist.gov/nvlap>.

1.6.2 NIST Handbook 150 Checklist

All NVLAP programs use the NIST Handbook 150 Checklist (formerly called the General Operations Checklist), which contains the requirements published in NIST Handbook 150. The checklist items are numbered to correspond to clauses 4 and 5 and annexes A and B of NIST Handbook 150.

1.6.3 NIST Handbook 150-1 Checklist

The NIST Handbook 150-1 Checklist (also referred to as the EEL Program-Specific Checklist) addresses the requirements specific to Energy Efficient Lighting Product testing given in NIST Handbook 150-1 with an emphasis on observing and performing tests, testing accuracy and uncertainty, traceability chain and associated calibration uncertainty of standard reference lamps and standard photometers, instrumentation, calibration, personnel competency, and test reporting. The checklist contains requirements expressed at a more detailed level than found in this handbook.

1.6.4 Test Method Review Summary

The assessor uses the Test Method Review Summary to review the laboratory's ability to perform the EEL test methods. The review of the test methods by the assessor ranges from observing tests to having laboratory staff describe the test procedures. The assessor notes on the Test Method Review Summary the depth into which each part of the test method was reviewed (Observed Test, Examined Apparatus, Walked/Talked Through Test, Listened to Description of Procedures).

1.6.5 NVLAP Lab Bulletins

NVLAP Lab Bulletins are issued to laboratories and assessors when needed, to clarify program-specific requirements and to provide information about program additions and changes.

2 LAP establishment, development and implementation

This clause contains no information additional to that provided in NIST Handbook 150, clause 2.

3 Accreditation process

3.1 General

An overview of the laboratory accreditation process is provided in NIST Handbook 150, clause 3, and includes information pertaining to application for accreditation; on-site assessment; proficiency testing; accreditation decision; granting accreditation; renewal of accreditation; changes to scope of accreditation; monitoring visits; and suspension, denial, revocation, and voluntary termination of accreditation.

3.2 Management system review

3.2.1 Prior to applying to NVLAP for accreditation, a laboratory shall have a fully implemented management system. A copy of the management system documentation, including a cross-reference document, shall be sent to NVLAP with the application forms. This requirement applies to both applicant laboratories and laboratories already accredited by NVLAP (see 4.2.2).

3.2.2 The cross-reference document shall verify that all requirements of this handbook and clauses 4 and 5 and annexes A and B of NIST Handbook 150 are addressed and their locations clearly identified in the management system documentation. The cross-reference requirement is satisfied if the management system documentation is organized and numbered the same as the NIST Handbook 150 Checklist (see 4.2.2).

3.2.3 Prior to the on-site assessment, the assigned assessor reviews all relevant management system documentation for conformity with NVLAP requirements, including the requirements of this handbook and NIST Handbook 150. During this review, the assessor may request additional management system documents and/or records, which will be returned upon request.

3.3 On-site assessment

3.3.1 The purpose of the on-site assessment is to determine whether the laboratory is following its documented management system and to assess the competence of the laboratory's delivery of its testing services.

3.3.2 The on-site assessment will take place at the laboratory site. Prior to the visit, the NVLAP assessor provides a preliminary agenda, which may change due to findings observed during the on-site assessment. Efforts will be made to minimize disruption to the normal working routines during the assessment. The assessor will need time and workspace to complete assessment documentation during his/her time at the laboratory site.

3.3.3 All laboratory equipment required to perform accredited testing shall be available for assessment and in good working order. The laboratory shall be prepared to demonstrate selected test methods as requested by the assessor. The assessment will cover the requirements identified in this handbook, NIST

Handbook 150, the EEL Program-Specific Checklist, the laboratory's management system documentation, and the laboratory's written detailed test instructions.

3.3.4 The laboratory shall make available all supporting technical information in a format that is conducive to a detailed review. The assessor may request additional information to clarify issues regarding nonconformities or to delve more deeply into technical issues.

3.3.5 The activities covered during a typical on-site assessment are described below.

a) *Opening meeting:* The NVLAP assessor will meet with laboratory management, supervisory personnel, and other appropriate staff members to explain the purpose of the on-site assessment and to discuss the schedule for the assessment activities. Information provided by the laboratory on its application form may be discussed during this meeting.

b) *Staff interviews:* The NVLAP assessor will ask the laboratory manager to assist in arranging times for individual interviews with laboratory staff members. The assessor will interview staff members filling key positions (e.g., Laboratory Manager, Technical Director, Quality Manager, Authorized Representative, Approved Signatories) and staff members who have an effect on the outcome of the testing, including staff who conduct the testing. The assessor does not need to talk to all staff members; however, the assessor will select staff members representing all aspects of the laboratory. These interviews are conducted to determine if the staff members are properly trained, assigned, and supervised, and are technically competent for the tasks assigned to them.

c) *Records review:* The NVLAP assessor will review laboratory documentation, including the management system documentation, equipment and maintenance records, record-keeping procedures, testing procedures, laboratory test records and reports, personnel competency records, personnel training plans and records, and safeguards for the protection of sensitive and proprietary information. The assessor will review the laboratory's own detailed instructions (see 5.4.1) to perform EEL testing according to the standard test procedures for which it seeks accreditation, the range of energy efficient lighting products and conditions it can test, and the descriptions of the maintenance and calibration of its specific equipment. The assessor will also review:

    1) sample identification and tracking procedures and copies of completed test reports;

    2) records of internal audits, use of quality control procedures, and participation in NVLAP proficiency testing or other similar programs;

    3) personnel records, including résumés and job descriptions of key personnel and competency evaluations for all staff members who routinely perform the test method for which accreditation is sought;

    4) calibration records and certificates (see 5.6.5 and 5.6.6);

    5) records of evaluations, verifications and testing of purchased services, equipment, etc. (see 4.6).

    Laboratory staff shall be available to answer questions pertaining to the accreditation review; however, the assessor may wish to review the documents and records alone. The assessor usually does not ask to remove any laboratory documents or records from the laboratory premises.

NVLAP assessors do not need access to employee information that may be considered sensitive or private such as salary, medical information, or performance reviews for work done outside the scope of the laboratory's accreditation. However, this information is often stored together with technical information that an assessor will need to check (e.g., job descriptions, résumés, and technical performance reviews). In these cases, the assessor will work with the laboratory to ensure the review is performed without violating individual privacy. At the discretion of the laboratory, a member of its human resources department may be present during the review of personnel information.

d) *Internal audit and management review:* The assessor will review and discuss with the laboratory staff the laboratory's internal audit and management review activities, which are separate and distinct activities. The discussion will include all aspects of those activities including the management system procedures, the audit findings, the root cause determination, the actions taken to resolve problems identified, the actions taken to prevent recurrence, and the results of the management review.

e) *Equipment and software:* The assessor will examine and determine the suitability of all equipment and facilities required to perform the standard test methods for which the laboratory is accredited (or is seeking accreditation). The appropriate environmental conditions required for testing will be assessed. The assessor will observe the demonstration of selected procedures by appropriate personnel assigned to conduct the tests, and will interview those personnel. The assessor will review test data, examine hardware and software for function and appropriateness, and review software validation and verification procedures.

f) *Demonstrations:* The demonstrations requested may be selective or all-inclusive. The NVLAP assessor will observe the demonstration of testing procedures by technical personnel assigned to conduct the tests, and will discuss the tests with the technical personnel to assure their understanding of the procedures. The demonstrations shall include sample energy efficient lighting product(s), preparation of devices, establishment of test conditions, and the setup/use of major equipment. The assessor will use the Test Method Review Summary (see 1.6.4) and the EEL Program-Specific Checklist (see 1.6.3) in reviewing and summarizing the laboratory's ability to conduct the test methods.

The assessor may select and trace the history of one or more energy efficient lighting product samples from receipt to final issuance of the test reports.

g) *Proficiency testing:* The assessor will discuss all aspects of proficiency testing results with appropriate staff. Test methodology and records documenting the laboratory's execution of the testing will be reviewed and discussed. Any unusual trends or outlying results will be discussed.

The assessor may provide an energy efficient lighting product(s) as a proficiency test specimen and request testing or a demonstration.

h) *On-site assessment report:* The assessor will complete an On-Site Assessment Report, which summarizes the findings and clearly lists all nonconformities and comments (positive or negative). This report normally consists of the On-Site Assessment Summary, the On-Site Assessment Narrative Summary, the NIST Handbook 150 Checklist, the EEL Program-Specific Checklist, and the Test Method Review Summary. The first page of the report shall be signed by the assessor and the laboratory's Authorized Representative or designee to acknowledge receiving the on-site report, but this does not necessarily indicate agreement by the laboratory. A copy of the report will be given to the laboratory representative for retention and the assessor will

send the original to NVLAP. All observations made by the assessor will be held in the strictest confidence.

i) *Closing meeting:* The assessor will conduct a closing meeting with the laboratory manager, supervisory personnel, and other appropriate staff members to discuss the findings. During the visit the assessor will have categorized all problems identified as nonconformities and comments. They will be discussed at the closing meeting and resolutions may be mutually agreed upon. The assessor will specifically note items that have been corrected during the on-site assessment along with any recommendations for other action(s). The process for resolving nonconformities identified during the on-site is documented in NIST Handbook 150. Disagreements between the laboratory and an assessor may be referred to NVLAP for resolution.

3.3.6 The laboratory shall resolve or formulate a plan to resolve all nonconformities and provide a response to NVLAP within 30 days from the date of the on-site assessment. In the case of an initial accreditation, all nonconformities shall be satisfactorily resolved before accreditation can be granted.

3.3.7 The laboratory shall review all comments for potential improvements in energy efficient lighting product testing.

3.4 Proficiency testing

3.4.1 NIST Handbook 150 defines proficiency testing and describes how it is included in the accreditation process. EEL test methods that require proficiency testing are identified by an asterisk (*) in the EEL Test Method Selection List. Special proficiency testing rounds may be scheduled separately for specific needs. Proficiency testing fees are required from all laboratories accredited for one or more test methods for which proficiency testing is being offered.

3.4.2 As NVLAP prescribes, NVLAP or a proficiency testing contractor conducts rounds at regular intervals. Energy efficient lighting specimens along with instructions for specimen handling, preparation (including seasoning and pre-burning), conditioning, mounting, and testing, and data forms are provided to the participating laboratories. The completed test data forms are sent by the participating laboratories to NVLAP or, as directed, to the proficiency testing contractor. The results of all participants are summarized in a Tech Brief, which is edited and sent by NVLAP to the participants. The identity and performance of individual laboratories are kept confidential.

3.4.3 Laboratories renewing accreditation shall have satisfactorily participated in all required proficiency testing during their previous accreditation period. Laboratories applying for initial accreditation shall also participate satisfactorily in proficiency testing (or a suitable alternative, if available), provided the proficiency testing is offered during the application period, before accreditation will be granted.

Failure to participate in proficiency testing or return the completed test data forms by the deadline is considered a nonconformity and may result in suspension of laboratory accreditation for those test methods in question.

3.4.4 Generally, it is required that the specific proficiency test procedure be conducted in accordance with the applicable standard test method. At times, however, NVLAP may specify special conditions to assure uniformity in procedures and test conditions among participants. These may include the number of replicate measurements, special conditions of temperature, and other test parameters. Also, proficiency testing may consist of several parts in order that the operation of a laboratory might be evaluated.

Portions of the standard test procedure may be emphasized, such as measurement, instrumentation, hardware, and data analysis. **The proficiency testing shall not be contracted out to another laboratory.**

3.4.5 Proficiency test data are analyzed using statistical procedures to determine distributions and parameters, such as averages, standard deviations, and outliers (see ASTM E178). Using the test data from proficiency testing, the laboratory shall monitor its own testing performance. Procedures for analyzing and monitoring the laboratory's own test results shall be documented in its management system.

3.4.6 Unsatisfactory performance in proficiency testing (e.g., outlying results) is a technical nonconformity that must be resolved by the laboratory to maintain its accreditation for the test method(s) in question. If the laboratory performs unsatisfactorily in any proficiency test, it shall take corrective action to investigate and resolve nonconformities in a timely manner, according to the requirements of NIST Handbook 150 for the control of nonconforming work. Unsatisfactory performance in proficiency testing may result in suspension or revocation of accreditation.

3.4.7 The results of proficiency testing are made available to NVLAP assessors for use during laboratory on-site assessment visits. Any problems indicated by proficiency testing shall be discussed with appropriate laboratory personnel responsible for developing and implementing plans for resolving the problems.

4 Management requirements for accreditation

4.1 Organization

There are no requirements additional to those set forth in NIST Handbook 150.

4.2 Management system

4.2.1 The laboratory shall ensure that the requirements of NIST Handbook 150 are met so that staff are knowledgeable of the electronic- or paper-based documentation system and can demonstrate, if authorized, the retrieval of needed documents and/or records.

4.2.2 The laboratory shall create a cross-reference document allowing the laboratory and a NVLAP assessor to verify that all requirements of clauses 4 and 5 and annexes A and B of NIST Handbook 150 and the corresponding NIST Handbook 150-1 are addressed in the management system documentation. The cross-reference document requirement can be satisfied in a number of ways. One way is to number and organize the management system documentation to be the same as the NIST Handbook 150 Checklist.

4.2.3 The laboratory shall have readily available the latest published version of all of the EEL test methods for which accreditation has been requested.

4.2.4 If a customer, for whatever reason (e.g., regulatory requirement), requires accreditation to versions of a test method that are not the latest published version, then the laboratory shall document that requirement and shall have readily available the required version of the test method.

4.2.5 When a test method references another test method, guide, practice, or specification, the laboratory shall have readily available the referenced documents, where relevant.

4.2.6 Laboratories seeking or holding accreditation to IES LM-58 on Spectroradiometric Measurements shall have readily available a copy of Commission Internationale de l'Eclairage (CIE) Publication No. 13.2, *Method of Measuring and Specifying Color Rendering of Light Sources.* This publication is a reference document for the calculation of the color rendering index (CRI) of the test specimens from the results of the spectroradiometric measurements.

Laboratories seeking or holding accreditation to IES LM-58 shall also have readily available a copy of IES LM-16, *Practical Guide to Colorimetry of Light Sources*, which provides background information and commentary on colorimetry procedures and techniques.

4.2.7 In addition to the information specified in NIST Handbook 150, the management system documentation shall include:

a) testing facilities and scope of services offered;

b) policy and procedures for use of subcontractors, if applicable;

c) procedures and actions concerning damaged or altered energy efficient lighting test specimens;

d) procedures by which the laboratory describes the energy efficient lighting specimen and the criteria for determining if the specimen is to be accepted or rejected, e.g., rejected due to damage or outside the testing range [see 4.2.7.e)];

e) the type (both lamps and luminaires) and range (e.g., size, shape, level of light output) that a laboratory can test for each test method (see note below);

f) procedures for maintenance and calibration of the equipment used in conducting the tests on energy efficient lighting products;

g) procedures for the laboratory's participation in NVLAP proficiency testing, including analyzing and monitoring the laboratory's results, a description of any corrective actions taken because of the results, and procedures for comparing the laboratory's proficiency test results with those from other NVLAP-accredited laboratories;

h) the personnel training and competency evaluations that demonstrate that the test procedures are being conducted correctly.

NOTE In some cases, a laboratory's equipment may be limited so that the laboratory cannot measure the properties of the complete range of specimens. Therefore, the laboratory's testing capability is documented by listing the type and range of specimens it can test.

4.3 Document control

There are no requirements additional to those set forth in NIST Handbook 150.

4.4 Review of requests, tenders and contracts

The laboratory shall ensure that it has the required capability [see 4.2.7 e)] to conduct the testing.

4.5 Subcontracting of tests and calibrations

There are no requirements additional to those set forth in NIST Handbook 150.

4.6 Purchasing services and supplies

The laboratory shall evaluate vendors and verify or test incoming services, equipment, software, materials, and supplies that affect the quality and accuracy of the test results. Examples include general laboratory equipment and supplies, equipment vendors, data acquisition and processing equipment, software vendors, software packages for data processing and calculations, calibration services and certificates, standard reference lamps, secondary (working) reference lamps, and standard photometers. Records that these evaluations, verifications, and testing of services, equipment, etc. have been reviewed for technical completeness will be examined by the assessor.

4.7 Service to the customer

There are no requirements additional to those set forth in NIST Handbook 150.

4.8 Complaints

There are no requirements additional to those set forth in NIST Handbook 150.

4.9 Control of nonconforming testing and/or calibration work

There are no requirements additional to those set forth in NIST Handbook 150.

4.10 Improvement

There are no requirements additional to those set forth in NIST Handbook 150.

4.11 Corrective action

There are no requirements additional to those set forth in NIST Handbook 150.

4.12 Preventive action

There are no requirements additional to those set forth in NIST Handbook 150.

4.13 Control of records

4.13.1 In addition to the requirements in 4.13.2.1 of NIST Handbook 150 to identify the personnel responsible for sampling, testing, calibration and checking results, the personnel responsible for specimen preparation, and where appropriate, the associated date(s), shall also be identified in the records (test/calibration/verification, etc.; hard copy and electronic).

4.13.2 Records will be reviewed during the on-site assessment either in total or by selective sampling.

4.13.3 The records to be maintained include (but are not limited to):

a) acceptance/rejection (e.g., rejected due to damage) of lamps and luminaires submitted for test [see 4.2.7 d) and 4.2.7 e)];

b) comprehensive logs for tracking specimens and test activities;

c) original data collected by laboratory;

d) calibration and verification data;

e) data and results of quality control;

f) equipment and maintenance records;

g) test reports.

4.13.4 Test records, sufficient to reconstruct the test report, shall be kept for a period of at least three years following the issuance of a test report, unless a longer period is required by the customer, regulation, or the laboratory's own procedures.

4.14 Internal audits

4.14.1 The internal audit shall cover compliance with NVLAP, laboratory management system, regulatory, contractual, and testing requirements.

4.14.2 An applicant laboratory shall conduct at least one complete internal audit prior to the first on-site assessment. The records will be reviewed by the NVLAP assessor before or during the on-site assessment visit.

4.14.3 For accredited laboratories, internal audit reports conducted since the previous on-site assessment shall be made available for review.

4.14.4 Internal audits are separate and distinct from management reviews (see 4.15).

4.15 Management reviews

4.15.1 Periodic reviews of the management system shall reflect adherence to NVLAP requirements and the laboratory's quality objectives.

4.15.2 Management reviews shall review all nonconformities and may reflect positive aspects of the management system.

4.15.3 An applicant laboratory shall perform at least one complete management review prior to the first on-site assessment. The records will be reviewed by the NVLAP assessor before or during the on-site assessment visit.

4.15.4 The report of the management review shall be available during the NVLAP on-site assessment.

5 Technical requirements for accreditation

5.1 General

There are no requirements additional to those set forth in NIST Handbook 150.

5.2 Personnel

5.2.1 Personnel records

5.2.1.1 ***Key NVLAP accreditation personnel —*** The laboratory shall maintain a list of personnel designated to fulfill NVLAP requirements including: Laboratory Director, Technical Director, Team Leaders, NVLAP Authorized Representative, NVLAP Approved Signatories, and the staff responsible for conducting the testing.

5.2.1.2 ***All testing laboratory staff —*** The laboratory shall document and maintain records on the required qualifications of each staff member, including a résumé of qualifications; laboratory testing procedures to which the person is assigned and authorized to perform; and the results of periodic testing performance (competency) reviews (see also 5.2.3.4), which may include interlaboratory testing and/or repeated testing by the same operator or comparative testing with two or more operators.

5.2.1.3 ***Notification of changes —*** The laboratory shall notify NVLAP when key personnel (see 5.2.1.1) are added to or removed from the staff. Notification to NVLAP of personnel changes shall include a current résumé for each new staff member.

5.2.2 Specific experience and competence of Technical Director

The laboratory's Technical Director (or an appropriate supervisor) shall be experienced in energy efficient light product testing and shall have the technical competence and the supervisory capability to direct the work of professionals and technicians in energy efficient light product testing.

5.2.3 Competency reviews

5.2.3.1 The EEL Program-Specific Checklist lists specific personnel competency requirements as related to testing.

5.2.3.2 The laboratory shall evaluate the competency of each staff member for each test method the staff member is authorized to conduct.

5.2.3.3 For each staff member, the staff member's immediate supervisor, or a designee appointed by the Laboratory Director, shall conduct annually an assessment and an observation of performance competency.

5.2.3.4 These annual performance competency reviews shall be documented, dated, signed by the supervisor and the employee, retained in the personnel files and be available for review by the assessor. For the purpose of on-site assessments, a separate personnel folder of information specific to applicable NVLAP requirements may be provided instead of the complete folder, which may contain confidential information not needed for the assessment.

5.2.4 Training

5.2.4.1 The laboratory shall have a description of its training program for ensuring that staff is able to perform tests properly.

5.2.4.2 The training program shall be updated and current staff members shall be given additional training when test methods are updated or procedures change, or when the individuals are assigned new responsibilities.

5.2.4.3 Each staff member may receive training for assigned duties either through on-the-job training, formal classroom study, attendance at conferences, or another appropriate mechanism.

5.2.4.4 The laboratory shall ensure that each new staff member is trained for the testing duties assigned. Minimum training requirements are described in the EEL Program-Specific Checklist.

5.2.4.5 Training materials that are maintained within the laboratory shall be kept up-to-date, including applicable versions of standard test methods, as well as appropriate reference documents, texts, and scientific and industry periodicals. These materials shall be readily available to the laboratory staff.

5.2.5 Subcontractors

Individuals hired to perform testing activities are sometimes referred to as *subcontractors*. NVLAP does not make a distinction between full-time laboratory employees and individuals hired on a contract to work in that laboratory. NVLAP requires that the EEL testing laboratory maintain responsibility for and control of any work performed within its scope of accreditation. The laboratory shall ensure all individuals performing testing activities satisfy all NVLAP requirements, irrespective of the means by which individuals are compensated (e.g., the laboratory must ensure all test personnel receive proper training and supervision and are subject to annual performance reviews, etc.).

5.3 Accommodation and environmental conditions

5.3.1 The laboratory workspace and environmentally controlled spaces shall be checked for compliance to the required conditions.

5.3.2 Monitoring and control devices shall be calibrated and functioning properly so as to maintain and record the required environmental conditions.

5.3.3 Specific environmental requirements for EEL laboratories are provided in the EEL Program-Specific Checklist.

5.4 Test and calibration methods and method validation

5.4.1 Standard test methods

5.4.1.1 The management system documentation shall contain or make reference to detailed written documentation of the procedures, practices, instructions and equipment that the laboratory uses in conducting the test methods for the different types of lamps and luminaires for which it seeks or holds accreditation. These detailed instructions, including those for equipment operation, calibration checks, and quality control checks, shall address any laboratory-specific information not contained in the standard method. When necessary, the test method shall be supplemented with additional detailed instructions beyond the test method to ensure consistent application.

5.4.1.2 The photometric, colorimetric, and electrical test procedures included in the EEL Program have been developed to be generally applicable to a variety of lamps and luminaires that differ by factors such as size, shape, spectral characteristics, and intensity. As a consequence, the management system documentation shall include laboratory-specific (see 5.4.1.1) detailed descriptions of the operation and calibration of the test equipment and instrumentation the laboratory uses for the particular type(s) of lamps and luminaires it tests.

5.4.1.3 The Illuminating Engineering Society (IES) LM-58 (NVLAP Code 22/C01), *Spectroradiometric Measurements*, prescribes in general terms the instrument and measurement requirements, calibration procedures, and physical standards for conducting the measurements, but is not specific as to instrument, object, or material. Laboratories seeking or holding accreditation for colorimetric measurements of light sources conducted in accordance with IES LM-58 shall include, in the management system documentation, detailed laboratory-specific (see 5.4.1.1) descriptions of the procedures it uses to conduct the tests.

5.4.2 Off-site testing

5.4.2.1 A laboratory may be accredited for tests conducted at locations other than the laboratory's own facilities provided the testing complies with all NVLAP requirements. Examples of off-site testing are sampling and testing at off-site locations, such as a manufacturing facility, warehouse, or construction site.

5.4.2.2 The laboratory shall maintain records of its off-site testing.

5.4.2.3 If a laboratory selects off-site testing to be included in its scope of accreditation, it shall provide to the NVLAP assessor the following:

a) complete step-by-step procedure for personnel to follow when performing the standard off-site test;

b) demonstration of the test procedure;

c) folder or file containing raw data from off-site tests;

d) test reports and test data sheets;

e) demonstration of compliance with NVLAP calibration and traceability requirements;

f) evidence that adequate supervision during the off-site testing is provided by a qualified staff member of the accredited laboratory.

5.4.3 Additional requirements

The EEL Program-Specific Checklist contains additional requirements related to test methods, test equipment, calibrations, traceability chain and associated calibration uncertainty of standard reference lamps and standard photometers, and conduct of tests.

5.4.4 Estimation of measurement uncertainty

At a minimum, the management system documentation shall list the important components that substantially affect the uncertainty of the test results. This can be done for groups of similar test methods (e.g., grouped by electrical, photometric (intensity, flux), colorimetric, or life-performance properties) rather than for each test method. The uncertainty shall be determined and reported if required by the test method, the regulator, or the customer.

5.5 Equipment

The EEL Program-Specific Checklist contains additional requirements related to testing equipment (see 5.6.2).

5.6 Measurement traceability

5.6.1 By definition, measurement traceability is an attribute of the measurement result. Therefore, it applies to the result of the test as it relates to a stated reference. However, traceability is established to the stated reference usually through the calibration of the measurement and test equipment (M&TE) used to conduct the test, and/or through the use of standard reference materials, each with a known value(s) and a previously established path of traceability. Uncertainty is also an attribute of the measurement result and is therefore necessary for traceability to exist.

5.6.2 To account for the effects on traceability of the calibration of M&TE, the laboratory shall determine equipment calibration, verification, and maintenance intervals based on the equipment's frequency of use and the environment in which it is used, and also in accordance with standard test methods, manufacturer's recommendations, or as specified in the EEL Program-Specific Checklist, whichever results in a shorter time between calibrations. Extension of the time interval between calibrations is acceptable if the laboratory can provide justification for increasing the interval.

5.6.3 Proper performance of the testing equipment shall be periodically verified as needed.

5.6.4 The reference standards used and the environmental conditions at the time of calibration shall be documented for all calibrations.

5.6.5 The following requirements apply for calibrations and calibration certificates.

a) Certificates are required for calibrations performed by outside services. A calibration certificate shall indicate uncertainty or accuracy tolerance limits, and traceability of reference standards.

b) Certificates may not be required when a laboratory performs its own calibration and records are kept. If the testing laboratory performs its own calibration, the identity of the personnel involved, the standard metrological procedures used, the environmental conditions, and the measurement uncertainty shall be documented. These records shall contain sufficient information to permit repetition of the calibration.

c) For calibrations performed by the testing laboratory, it shall have properly trained personnel who understand the importance of the various factors that affect the uncertainty of the calibration and its effect on the uncertainty of the final test result (see NIST Handbook 150, 5.4.6).

d) Lamp testing laboratories, for their standard reference lamps and standard photometers, shall document each step of the traceability chain and, for each step, the magnitude of the associated uncertainty as stated on their calibration certificates (or the uncertainty as determined (or estimated) by the laboratory if it is an in-house calibration conducted by the laboratory).

5.6.6 In addition to the information specified in NIST Handbook 150, 5.5.5, calibration or verification records shall include the following:

a) a list of all equipment variables requiring calibration, traceability, or verification;

b) range of calibration/traceability/verification;

c) resolution (precision or the number of digits read) of the instrument and its allowable error (i.e., tolerance);

d) periodic verification dates and schedule;

e) identity of the laboratory individual/group or external service responsible for calibration;

f) identity and source of reference standard(s) and traceability.

5.7 Sampling

There are no requirements additional to those set forth in NIST Handbook 150.

5.8 Handling of test and calibration items

The EEL Program-Specific Checklist contains additional requirements related to preparation and handling of test items.

5.9 Assuring the quality of test and calibration results

There are no requirements additional to those set forth in NIST Handbook 150.

5.10 Reporting the results

5.10.1 General

5.10.1.1 Where appropriate, test reports shall clearly state that the test results apply to the product or system as tested and, if required, conform to regulatory requirements.

5.10.1.2 Additional requirements are provided in the EEL Program-Specific Checklist.

5.10.2 Data analysis and report generation

5.10.2.1 In some cases, raw data collected by computer are collated, reduced, analyzed, or otherwise treated for direct incorporation in the test report. Such treatment involving transmission of the data, writing, and generation of the test report is generally performed at the laboratory or at an area close to the facility and under the control of laboratory personnel. In such cases, the laboratory personnel responsible for the report writing and generation shall be available during the laboratory's on-site assessment to be interviewed by the assessor for evaluation of the laboratory's compliance with the NVLAP criteria for test reports.

5.10.2.2 At times, the final report may be written and generated at an off-site facility that is located some distance from the testing laboratory such that the assessor cannot interview the off-site personnel. In such a case, the laboratory shall have in place for assessor review appropriate written descriptions in the management system documentation of procedures and documentation for assuring the accuracy and validity of the data transmission, the incorporation and accurate analysis of the data in the test report, and the compliance of the test report with NVLAP criteria. Depending on the on-site laboratory evaluations of these written descriptions, a visit to the off-site facility may be required. When warranted, an assessor will visit the off-site facility at additional cost to the laboratory before accreditation is granted or renewed.

5.10.2.3 When a test report is written at an off-site facility such that the assessor cannot interview the off-site personnel, the report shall include the names and addresses of both those responsible for conducting the laboratory tests and for writing and generating the test report. Copies of typical reports written at an off-site facility shall be available at the laboratory at the time of the on-site assessment and these typical reports shall be reviewed by the assessor for compliance with NVLAP requirements.

5.10.2.4 If a laboratory uses several organizational departments for the discrete functions of testing, data collection, data processing, and test report preparation and generation, it is necessary that lines of responsibility with distinct supervisory positions be defined and that no conflicts exist. The assessor shall review the procedures and documentation of the lines of responsibility with distinct supervisory positions during the on-site assessment, and also shall verify that all NVLAP requirements regarding the writing and storage of reports are followed.

6 Additional requirements

There are no additional requirements beyond NIST Handbook 150 and its associated normative annexes, and any other normative references previously cited in this handbook.